RESEARCH HIGHLIGHTS

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SURVEY OF IN-SUITE SPACE AND DOMESTIC HOT WATER HEATING SYSTEMS IN MULTI-RESIDENTIAL BUILDINGS

INTRODUCTION

Historically, space and domestic hot water heating in multi-unit residential buildings was provided by either central hot water boilers or was a combination of in-suite electric baseboards and central domestic hot water boilers. More recently in some areas of Canada, the availability of lower cost natural gas and the development of direct vent, induced draft and sealed combustion space heating and domestic hot water appliances has encouraged the application of gas-fired furnaces and domestic hot water heaters within individual apartments. In such cases, natural gas is piped directly to each apartment and is usually metered. This strategy is often called the "in-suite" system approach.

In-suite systems are thought to offer many advantages over central systems. Supervision and maintenance of central systems can be eliminated. Individual apartments can be metered for energy use. In-suite systems may provide better individual control of indoor air temperatures. Occupant comfort can be enhanced as it is not dependent upon the operation of the central systems. In some areas, in-suite space and domestic hot water heating equipment can be leased from the utility thereby reducing capital costs. However, such systems require more space within each apartment, require occupant input for operation and maintenance, require many building envelope penetrations and are not easily convertible to alternative fuels.

Overall, the pros and cons of in-suite systems are not well characterized as operational experience has been relatively short and there has not yet been a widespread uptake of in-suite systems. In order to provide an early look at the operational performance of in-suite systems CMHC initiated a research project to survey buildings with in-suite systems in order to characterize energy use, operating and maintenance costs, design and construction implications and the owner's, manager's and occupant's degree of satisfaction with such systems. This information will help property owners, developers and designers to make appropriate space and domestic hot water heating design decisions for apartment building projects.

Research Program:

This study was based on collecting and analyzing data, accessing engineering experience with multi-residential systems, and studies conducted by other organizations. Interviews were conducted with engineers, developers, utility personnel, property managers and residents to get a firsthand account of practical experiences with in-suite systems.

The project involved the following steps. First, the gas-fired, in-suite space and domestic dot water (DHW) systems under consideration were defined and described.

Next, the information necessary to characterize in-suite systems was defined:

- Annual energy use and costs by suite and total building, gas and electricity.
- Developers' capital costs (installed)
- Operating and Maintenance costs
- System components and specifications
- Developers' reasons for specifying in-suite systems and subsequent experiences
- Operating and Maintenance considerations
- Mechanical design considerations
- Architectural considerations
- Metering approaches
- Levels of satisfaction of building owners, property managers.
- Occupants' assessment of their comfort, value and convenience
- Occupants' understanding of their HVAC and DHW systems

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Nine buildings with in-suite systems and cooperative stakeholders were located and interviews were undertaken to capture input from stakeholders. The buildings in the study were greater than 3 years old, more than 3 storeys in height, were of residential occupancy, and had natural gas fired space and domestic hot water heating appliances in each apartment. The information including billing histories from utilities and occupants (where they could be obtained) was compiled and consolidated in a final project.

FINDINGS:

The project revealed that in-suite natural gas-fired space and domestic hot water heating appliances are popular in Ontario. Utility equipment leasing programs encouraged the uptake of this approach. Buildings with in-suite systems are also found in the lower mainland of British Columbia and the Prairies. The in-suite system does not seem to have made significant market penetration in the Maritimes – likely due to limited access to natural gas. Consequently, the study was limited to the Greater Toronto Area of Ontario.

Three types of in-suite systems were studied in this project. One type of in-suite system surveyed consists of a combination space and domestic hot water heating system (Figure 1). Sealed combustion, gas-fired, domestic hot water tanks are used to provide hot water for space heating via a ducted fan-coil system. The same tank supplies domestic hot water. Other buildings were found to be equipped with separate, gas-fired, forced air furnaces (Figure 2). These systems are installed through the exterior wall of the building in each apartment for ease of venting combustion products. Separate gas-fired domestic hot water tanks were installed. The third in-suite system (Figure 3) employs separate instantaneous, gas-fired, hot water heaters to supply fan-coil units for space heating and domestic hot water needs. Where air-conditioning (cooling) is supplied, the equipment consisted of the conventional combination of a plenum mount evaporator coil with an outdoor condensing unit located on balconies, rooftops or a wall cavity open to the exterior. All systems were found to be typically controlled by a central wall mount thermostat. The estimated cost to install the in-suite systems studied was found to range from $8,000 - $11,500. Costs are reduced by $3,500 - $4,000 if the hot water tanks or through-wall furnaces were rented. Annual natural gas consumption ranged from 700 – 1,200 m^3 while electricity consumption ranged from 3,500 to 6,600 kWh (one building with low consumption was not included in these ranges). Overall, gas and electricity charges averaged $900 per year for the suites surveyed.

Figure 1 : Combination Space and Domestic Hot Water Heating System

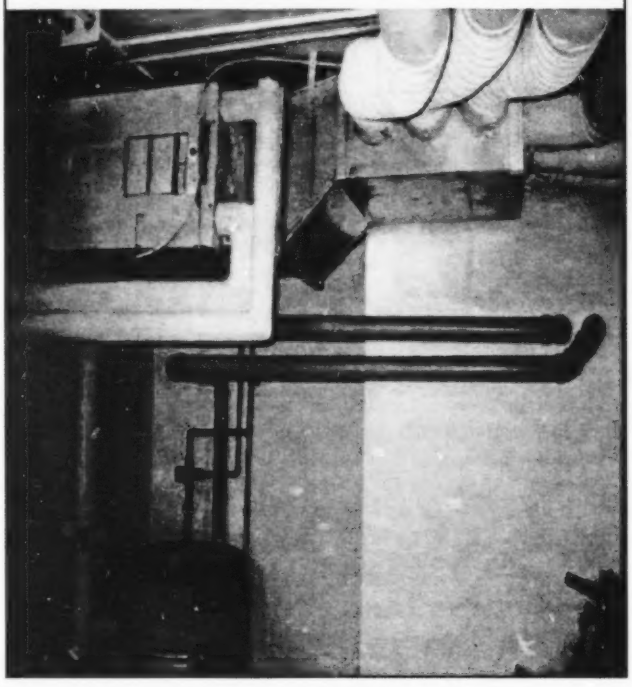
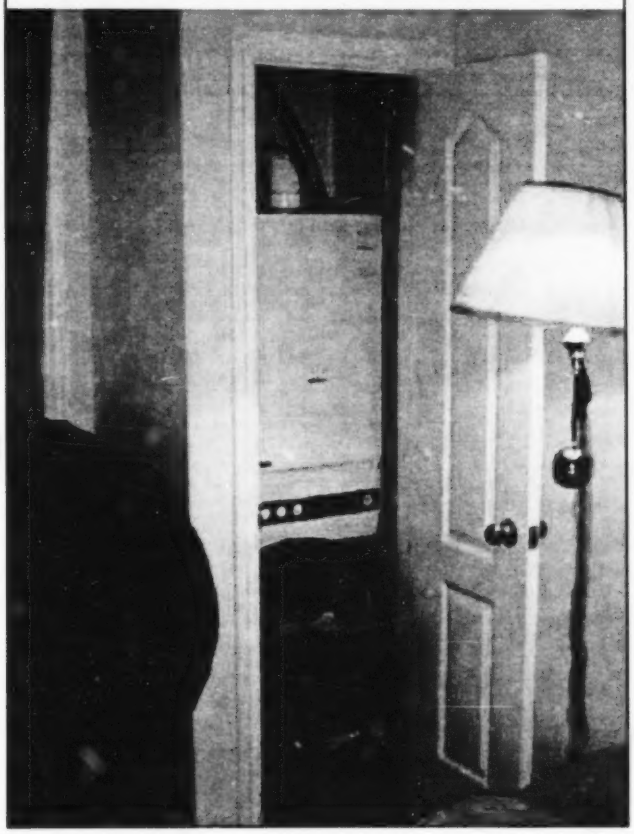


Figure 2 : Exterior View of a Through Wall Forced Air Heating System (Note combustion venting for domestic hot water tank above wall grille)

Figure 3 : Instantaneous Hot Water Heater located in Closet



Given the small survey size of 9 buildings in Ontario, the study's findings cannot be extrapolated to the stock of multi-unit residential building with in-suite systems in general. However, the data provides valuable insight into the experiences where in-suite systems have been installed. A discussion of the results follows.

High-rise residents of apartments with in-suite systems generally find such systems provide a high level of comfort conditions at a reasonable operating cost. They particularly liked independent control of conditions in their suite. Two-thirds of occupants said system type will play a role in the residents' next high-rise move, with in-suite as the system of preference. It was noted that the residents are not well informed of the operational and maintenance needs of their in-suite systems particularly in cases where their natural gas utility is responsible for service and repair of rented equipment

Architects tended to be critical of the design challenge posed by the need to provide floor space and/or outside wall space for in-suite appliances and the appearance of dropped ceilings and chases. Aesthetic compromises to the building's exterior to accommodate combustion fresh air and venting systems for the natural gas-fired appliances were also a source of concern.

Design engineers were found to be indifferent to type of system – central or in-suite. They felt that in-suite metering promotes conservation and may offer better occupant control but recognize that the rate structures of individually metered utility accounts can result in a higher utility costs.

Property Managers were found to be strong supporters of in-suite systems. Since the occupant owns the equipment or rents it from the gas utility, complaints to the manager relating to space conditioning or water heating virtually disappear. Building operations and maintenance are also simplified as there are no central space and DHW systems to look after (except for common areas). It should be noted that this favourable opinion may have been due to the recent vintage of the buildings surveyed and the lack of problems associated with aging equipment or system replacement. Additionally, in most of the buildings surveyed, the property management was not responsible for the in-suite equipment. In rental buildings where in-suite equipment is owned by the building owner, in-suite systems could result in greater in-suite maintenance obligations.

Developers were found to install in-suite systems in response to market demand for the lowest possible rents and condo fees, and improved control over comfort and occupancy costs. The developers surveyed share the concerns of architects with respect to the use of valuable exterior wall, floor area and balcony space for space conditioning systems. However, developers are aware that individually metered suites limit their gas and electricity bills to the common areas only (for rental buildings). Furthermore, gas utility equipment rental programs significantly reduce the capital cost of construction. In all, developers remain flexible, on a project-by-project basis, with respect to the types of systems they will use.

The project noted several technical issues relating to the design and installation of the in-suite systems. One of the primary concerns was that of access for maintenance. As space is limited with individual apartments, the mechanical systems tend to get put into spaces that are not conducive for routine repairs and maintenance. Access to filters, motor cabinets, controls and other components requiring regular service or repair can be obstructed by partitions and other mechanical and electrical systems in the space. In the case of combination space and domestic hot water heating systems, the function of the hot water tank thermostatic control is not well understood by any of the residents. Consequently, it can be incorrectly set by the residents and undermine the performance of the system. For all systems, there was generally a lack of operation and maintenance manuals provided for the space heating and domestic hot water heating equipment.

IMPLICATIONS FOR THE HOUSING INDUSTRY

The findings of this research project indicate that in-suite space and domestic hot water heating systems are a viable alternative to central systems. The development of in-suite systems offers developers and consumers greater choice in the types of systems that can be supplied to provide space heating and domestic hot water in multi-unit residential buildings and simplifies metering. However, in-suite systems represent a significant shift from conventional buildings where the property management is responsible for operating and maintaining heating, ventilating, air-conditioning and domestic hot water systems to the case where the suite occupant must assume these duties or allow access to their suites for others to undertake them. The degree to which the typical suite occupant is prepared to, or capable of, fulfilling such duties is unknown. Furthermore, the research issues and the design and installation requirements of in-suite systems are not as well understood as they are in the case of single family house applications. The multi-unit residential sector can benefit significantly from the experiences gained in the single family house sector in this regard – particularly in the preparation of design and installation guidelines, building codes and consumer support.

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Research Report: Survey of In-Suite Space and Domestic Hot Water Heating Systems in Multi-residential Buildings

Research Consultant: Finn Projects
(Synchronicity Projects Inc.)

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